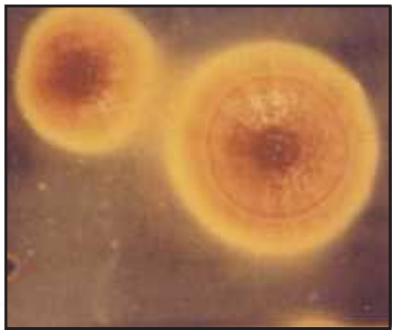
BIOLEACHING OF METALS FROM SULFIDE MINERALS

Most of the valuable metal that exists in the world's natural resources today lies ensconced in deep layers of sulfide deposits. Gone, for example, are the days of digging up 99 percent pure copper nuggets from the rich oxide deposits close to the surface. Today, modern miners extract rock from deep pits and pile it in million-ton ore heaps. They leach valuable minerals such as gold and copper by spraying water and chemicals over the heaps' surfaces. But they recover less than 40 percent of the metal in the heaps, because no one completely understands the leaching process, which microbes control.

Researchers at the Idaho National Engineering and Environmental Laboratory are working to accelerate natural microbial recovery of metals from low-grade sulfide minerals. They have assessed the health of these microbial communities in mining heaps and advised companies on how to improve or restart the leaching process. In the laboratory, they have manipulated ore heap environments and recovered 40 to 50 percent of the metal from sulfide ores, an increase that could produce several million dollars in additional income if replicated on mining ore heaps.



Sulfur oxidizing microbes

To date, INEEL researchers have examined the microbial ecology in ore heaps and discovered that a much wider range of microbes exists than has been reported in the scientific literature. They are defining the role of these different types of microbes and evolving a picture of the nutritional cycles in which one class of microbes promotes the growth of other classes of microbes. They have also discovered that changing water chemistry, which often occurs in ore heaps, slows or prevents microbes from recovering metals, because the microbes are affected by complex biochemical reactions.

They have also examined microbes present in subsurface chalcopyrite porphury deposits, commonly found at depths greater than 1000 feet below the land surface. They hope to identify bacteria that can extract copper from these deposits, and develop strategies to recover the copper by using a biological process.

The scientists have also developed biological strategies for leaching arsenopyrite ores, improving arsenic resistance in acidophilic bacteria, mitigating acid rock drainage,

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degrading cyanide in gold mining operations, and reducing selenium and chromium.

INEEL researchers plan to work with a mining company to instrument and study heap leach environments to develop a set of parameters that can be applied generally to mining operations. The research at INEEL into bioleaching of metals from sulfide is providing the basis for an anticipated change in mining operations from conventional industrial processes of physical crushing of rock and chemical extraction, to include engineering microbes' work. This is long-term research that the mining industry cannot afford to carry out, and is so applied that academic communities are not likely to investigate it. However, as domestic and international high grade copper reserves are depleted, the long-term payoff for this research is quite high.

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